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RM-4570-PR
MAY 1965

PUBLIC POLICY TOWARD SUBCONTRACTING

Robert E. Johnson and George R. Hall

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PREFACE

This study should be of interest to students of military procurement in general. It is directed primarily to policy makers who deal with the many procurement problems associated with the acquisition of major weapon systems.

Procurement research is a continuing activity at RAND. This is the first of several studies that will deal with important issues of public policy in defense procurement.

The authors wish to thank several people for their advice and assistance during the course of this study. Officials of Lockheed Aircraft Corporation were especially helpful in providing information on the C-141 subcontract program. Lt Col Leonard Staszak aided in obtaining and interpreting some of the data used in this study. Significant contributions were also made by two RAND colleagues. Robert M. Paulson collected some of the data and provided many valuable comments and suggestions. Sidney S. Handel was very helpful in developing the theoretical analysis. K. L. Deavers and R. L. Perry also provided valuable comments and suggestions.

SUMMARY

This Memorandum considers the rationale for public regulation of subcontracting, analyzes current subcontracting policy, and suggests changes in current policy. The need for subcontracting regulation in the acquisition of weapon systems depends on the method used to select a prime contractor and the type of contract between the prime contractor and the Government.

There are three cases. First, with a firm-fixed-price contract let by effective price competition, market forces provide all necessary subcontract regulation. Second, with a fixed-price-incentive contract let by effective competition, the Government need not be concerned with subcontractor selection. There may still be a need to regulate make-or-buy decisions, however, because contractors may elect to produce items inefficiently in-house in order to acquire new capital facilities partly financed by public funds. Third, for all contracts let without effective price competition -- these include but are not limited to all cost types of contracts -- the Government should be concerned with decisions both about which items to subcontract and which firms are to receive the subcontracts. Such regulation is needed because prime contractors lack the motivation to minimize target costs. This paper focuses on the third case. Not only is this case quantitatively the most important in the present procurement environment, but it is here that the opportunity lies for improvement in subcontracting policy.

The need for public concern about subcontracting is also brought out by an examination of the C-141 program, which has a number of atypical features. The most interesting aspect of this program is the extensive use of competitive bidding to choose subcontractors, which demonstrates the feasibility of extensive price rivalry. Furthermore, the wide variation in bid prices among potential suppliers provides important evidence that subcontracting decisions significantly affect the achievement of the Government's procurement goal of purchasing weapon systems at the least cost.

The analysis of current policy towards subcontracting focuses on three issues: Which items will be subcontracted? How are subcontractors to be selected? And, what provisions will be contained in the contract

between the prime contractor and the vendor? The changes in subcontracting policy that are suggested also focus on these questions. Attention is directed primarily to the more extensive use of competitive bidding -- both in the make-or-buy decision process and in the selection of subcontractors. Policy suggestions that deal with subcontract provisions focus on the follow-on procurement problem. The need here is to obtain price protection and flexibility in the face of uncertain demands. For this purpose the use of options shows great promise. Options have the important added advantage of permitting the initial selection of vendors to be based on total program costs, even when only a small portion of the funds is obligated at the outset of a program.

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I. STATEMENT OF THE PROBLEM

As a public-policy problem, subcontracting is unique to the defense industries. In other sectors of the economy, legislative and executive concern about subcontracting is seldom encountered and then only incidentally to broader problems of market power and business concentration. In contrast, the amount and nature of subcontract relationships among defense suppliers have been serious concerns of Congress and the Department of Defense as well as other executive agencies.* The special concern with subcontracting of defense products, particularly in the aerospace industry, has several causes. One is that when prime contractors have the primary responsibility for integration and coordination of weapon systems costing billions of dollars, it is natural to worry about whether they are allocating this money "fairly." "Fairly," of course, takes on many meanings depending on who uses the term and in what context. In discussions of the defense industries it often includes such diverse and complex ideas as equitable regional distribution, an equitable share of contract awards for small firms, and, even, maintaining the industrial base through widespread distribution of expenditures.**

Another cause of concern about defense subcontracting -- and one more likely to reflect disinterested motives -- stems from the possibility that an inappropriate subcontracting policy will increase the amount of

* Such as the Council of Economic Advisors, the Area Redevelopment Administration and the Small Business Administration.

** For example, the Armed Services Procurement Act of 1947 states that, "It is the policy of Congress that a fair proportion of the purchases made under this chapter be placed with small business concerns." 10 U.S. Code 2301. The Armed Services Procurement Regulation, Sec. 1, Parts 7 and 8, contains a listing of considerations that must be considered by contracting officials, such as the small business and labor surplus market programs. For a sharp demand that small business interests play more of a role in subcontracting, see U.S. Senate, Small Business Committee, 86th Cong., 1st Sess., Small Business Participation in Defense Contracting, Senate Report 716, August 13, 1959, Government Printing Office, Washington, D.C., 1959, pp. 19, 22-23.

market power or monopoly in the economy.* Most of the leading defense contractors are among the largest firms in the economy, measured by the amount of their assets, the proportion of business they account for in their industries, or the variety of their products. Firms such as General Motors, Chrysler, General Electric, General Dynamics, Boeing, Lockheed, and other giants come immediately to mind. In their roles as prime weapon-system contractors such firms make many decisions about what items they will produce themselves and who will receive subcontracts. It is not surprising, therefore, that many people desire assurance that such decisions are in the public interest and not designed to extend market power or enjoy its benefits.

A third reason for concern about subcontracting stems from a desire to assure that defense goods and services are acquired at minimum cost. In the past when most contracts were negotiated without competition, and cost-reimbursement contracts were usual, the incentives for prime contractors to minimize the cost of contractor-furnished equipment were not strong. Today, the emphasis is on obtaining rivalry in the contractor selection process, and fixed-price-incentive contracts are common. Nevertheless, the subordinate role played by price competition in prime contract awards, and suspicions about how "tight" target prices really are, lead many to worry about profit pyramiding, inflating the fee base, and other suspect subcontracting decisions that may tend to increase the final cost of a weapon system.

All three reasons for concern about subcontracting pose fascinating economic and policy problems, but this study will concentrate on the third reason. This emphasis reflects the policy of the Department of Defense to obtain military goods and services in the most economical fashion. The Department of Defense regards the socio-political aspects of procurement as primarily the responsibility of other agencies.** At least the ostensible

* Carl Kaysen and Donald F. Turner, Antitrust Policy, Harvard University Press, Cambridge, Mass., 1959, pp. 223-229.

** As a general statement of the objectives of procurement policy and its relationship to subcontracting, the following statement by then Deputy Secretary of Defense Gilpatric is instructive:

purpose of the contracting procedures used in about 95 per cent of the military purchases was to obtain some economically "best deal."* Consequently, it seems appropriate to examine subcontracting assuming that the Government's objective is to obtain military supplies at the least cost.

Looking at subcontracting through the prime contractor's eyes, subcontracting decisions are part of the process of determining the scope and extent of internal firm activities. This is partly a problem in design and technical capability. Clearly, in the short run the amount he can produce himself is limited by the nature of the weapon and by the facilities he possesses. Of course, over time such parameters can

"During the past fifteen months we have discussed on a number of occasions our basic policies and objectives in the expenditure of \$25 billion annually through Defense contracts. We have emphasized the necessity for prompt review and action on the findings of the GAO, our internal audit groups, congressional committees and outside sources which reveal the need to improve our procurement procedures.

I would like to re-emphasize the importance of close and continuing surveillance by each of you in order to assure that the following basic policies govern Defense procurement:

1. Our first and paramount objective is to acquire weapons and materiel which fully meet our qualitative, quantitative and delivery requirements -- at the lowest over-all cost.
2. To this end we must stress full and free competition, with equal opportunity to all interested qualified suppliers, and we must continuously seek to minimize sole-source procurements for end items, major sub-systems, spare parts and supplies. Whenever our specifications are sufficiently precise, we must obtain competition through formal advertised bidding procedures as required by law.
3. To the extent consistent with the above objective, we will give positive assistance to small business concerns, and to firms in surplus labor areas, to compete for Defense procurements, and we shall make full use of set-asides for these purposes as provided in the Armed Services Procurement Regulation. We must, however, assure that no premium is paid for the relief of economic dislocation, which is prohibited by law. "Defense Procurement Policies," Memorandum by Deputy Secretary of Defense, April 13, 1962. Quoted in Clarence F. Dixon and Harlan W. Tucker, "Qualitative Evaluation of Procurement Performance," An Advanced Logistics Report, AF-WP-O-Jan 63 150, The School of Logistics, Air Force Institute of Technology, Air University, Wright-Patterson Air Force Base, Ohio, 1962, pp. 61-62.

* Only about five per cent of the total dollar awards involved "set-asides" or other socio-political factors. Directorate of Statistical Services, OSD, Military Prime Contract Awards and Subcontract Payments, July 1963-June 1964, Office of Assistant Secretary of Defense, Installations and Logistics, Washington, D.C., n.d., p. 30.

be changed. And even in the short run, it seems likely that management can vary the proportion of a system subcontracted as profit opportunities present themselves.

The logic of a defense firm's make-or-buy decisions will be examined in Sec. II. This logic establishes the conditions under which public regulation of subcontracting is unnecessary as well as circumstances when public regulation is required to achieve the goals of procurement policy. The importance of subcontracting is also developed in Sec. III, where the C-141 procurement program is discussed.

Current regulation of subcontracting is discussed in Sec. IV and some changes are suggested. Section V considers the policy implications of the analysis. The implications center on three questions that must be answered in developing a subcontracting program: Which items will be subcontracted? How will the subcontractors be selected? What provisions will be contained in the contract between the prime contractor and his subcontractor?

Any military purchase may involve subcontracting. It is in the procurement of complete weapon systems, however, that the way make-or-buy decisions are made and subcontractors selected has the most important impacts on the cost of defense goods and services. Consequently, this study will focus on subcontracting in the acquisition of complete weapon systems.

To anticipate the following discussion, public regulation of subcontracting is unnecessary if fixed-price prime contracts are let by effective price competition. Regulation of subcontracting policy is required in all other cases, although the extent of regulation can be less if the prime contract is a fixed-price-incentive contract let by effective price competition. In determining the composition of the make-or-buy list and the recipients of the subcontracts, the use of competitive bidding is workable and has many advantages. Subcontracts should contain individually tailored pricing arrangements, and options are a useful procedure for dealing with follow-on procurements. With this brief preview, we now turn to subcontracting in the defense industries and to the decisions that determine its extent and the choice of subcontractors.

II. SUBCONTRACTING AND THE SCOPE OF THE FIRM

This section considers the extent of subcontracting by defense firms and the managerial decisions that determine the amount of subcontracting done by prime contractors. It identifies the conditions when public regulation of subcontracting is required in the procurement of major weapon systems. Thus, this section is concerned with the logic of subcontracting decisions by entrepreneurs and with the regulation of these decisions by the Government.

The term "subcontracting" will be used here as it is commonly used in the literature on procurement and the regulations governing military purchases. Subcontracting includes all purchases from other firms by a firm with a government contract in order to fulfill that contract.* Subcontracting thus includes items obtained by spot purchase orders as well as purchases involving longer contractual ties. Alternatively stated, subcontracting includes all the cost of an item delivered to the Government not accounted for by the "in-house" activity of the prime contractor.

The amount of subcontracting done by a firm may be measured by subtracting the value added by the prime contractor from his sales. Usually this measure is expressed as a percentage of the firm's sales, and this percentage will be called here, "the subcontracting ratio." The subcontracting ratio is directly related to a measure of vertical integration common in industrial organization studies called "the degree of fabrication."** The degree of fabrication is the ratio of value added to

*Excluding office supplies. 50 U.S.C. App., Sec 1212. 72 Stat 1789. Paul R. McDonald, Government Prime Contracts and Subcontracts, Procurement Associates, Glendora, Calif., 1961, p. K-1-2. The Armed Forces Procurement Regulation states that "... subcontract means any contract as defined in ASPR 1-201.4 other than a prime contract, entered into by a prime contractor or a subcontractor, calling for supplies or services required for the performance of one or more prime contracts." ASPR 8-101.24.

**For discussion of the use and limitations of this measure, see Ralph L. Nelson, Concentration in the Manufacturing Industries of the United States, Yale University Press, New Haven, Conn., 1963, pp. 78-81; and M. A. Adelman, "Concept and Statistical Measurement of Vertical Integration," in National Bureau of Economic Research, Business Concentration and Price Policy, Princeton University Press, Princeton, N.J., 1955, pp. 281-289.

sales or one minus the subcontracting ratio. As a result we can make use of studies of vertical integration to examine the extent of subcontracting. This is fortunate in view of the scarcity of data on purchases by prime contractors in the defense industries. In addition to past studies of vertical integration, some information is available from Bureau of the Census and Department of Defense reports. Although limited, the amount of data available on the extent of subcontracting is sufficient to support three propositions of importance to this study. First, aerospace firms have subcontracting ratios similar to other firms engaged in manufacturing, most of which are rather highly integrated. Second, many firms show a large variation in subcontracting over time. Third, there is a wide variation in subcontracting ratios among aerospace firms and among all other large firms.

The relevant data are shown in Tables 1, 2 and 3. Table 1 is derived from Department of Defense reports and shows that for large defense contractors as a group, in recent years about 48 cents of each dollar expended by the Government went to other firms and about 52 cents went to pay for factors of production used internally by the prime contractor. The subcontracting ratios vary from year to year and there appears to be a downward trend.

The temporal variation in subcontracting ratios is also brought out in Table 2 where the subcontracting ratios for all manufacturing corporations and the largest firms are shown for 1947 and 1954. Interestingly, the firms that entered the group of 50 largest firms in 1954 did less subcontracting than the firms that were in the 50 largest in both 1947 and 1954. Both the entering and remaining firms did less subcontracting than did the firms in the top 50 in 1947, but not in 1954. Of the 15 entering firms, 7 were aerospace companies.

Table 3 presents a more detailed examination of corporate integration. Subcontracting ratios for some of the large aerospace firms are listed above the double line. Below the double line in Table 3 are listed the subcontracting ratios for some large corporations in other industries. In recent years the large aerospace firms passed on approximately 52 to 62 cents out of every dollar of governmental sales to other firms. In

Table 1
SUBCONTRACTING BY LARGE DEFENSE FIRMS
(In \$ million)

A Fiscal Year	B Number of Firms Reporting	C Military Receipts ^a	D Subcontract Payments ^b	E Subcon- tracting ratio ^c
1957	298	16,992	9,314	54.8
1958	294	17,479	9,026	51.6
1959	298	18,704	9,144	48.9
1960	298	19,095	9,666	50.6
1961	309	19,803	9,407	47.5
1962	378	22,337	10,560	47.3
1963	453	23,667	11,411	48.2

SOURCE: Directorate of Statistical Services, OSD,
op. cit., p. 49.

^aMilitary contract receipts by reporting contractors
from prime and subcontract work.

^bMilitary subcontract payments by reporting con-
tractors. Subcontract payment: a cash payment made
by one contractor to another for supplies, services,
or construction required to fulfill a prime contract.

^c(D/C)100.

this respect aerospace firms are similar to other firms engaged in manufacturing, most of which are rather highly integrated. Many firms show a large fluctuation in subcontracting over time. In this respect aerospace firms are especially volatile. Finally, we note a large between-firm variation in the ratios, shown in Table 3.

In short, the amount of subcontracting by defense contractors or by all corporations varies substantially. Even within an industry there is usually wide variation. There is also a wide variation between the average subcontracting ratios of different industries. In addition, the subcontracting ratio for any specific firm is likely to vary over time. These findings lead to an important conclusion. The "correct" subcontracting ratio for a firm cannot be determined on the basis of general knowledge about an industry's technology, "conventional practice," or industry averages. Each firm, it appears from the data,

Table 2
SUBCONTRACTING BY ALL MANUFACTURING AND FIFTY LARGEST FIRMS
(In \$ million)

Group of Firms	1947			1954		
	A Value Added	B Sales	C Subcon- tracting Ratio ^b	D Value Added	E Sales	F Subcon- tracting Ratio ^c
All manufacturing corporations	68,419	150,692	54.6	100,550	248,496	56.1
Top 50 of 1947	12,753	36,880	65.4	24,604	63,307	61.1
Top 50 of 1954	12,033	33,345	63.9	29,955	65,174	58.6
15 entering top 50 in 1954 ^a	1,235	2,746	55.0	4,623	9,657	52.1
35 remaining in top 50	10,799	30,599	64.7	22,332	55,518	59.8
15 leaving top 50	1,955	6,281	68.9	2,273	7,790	70.8

SOURCE: Nelson, op. cit., p. 94.

^aIncluding 7 aerospace firms.

^b100 - [(A/B)100].

^c100 - [(D/E)100].

Table 3

SUBCONTRACTING RATIOS OF SELECTED AEROSPACE AND OTHER MANUFACTURING FIRMS^a

Firm	1949	1953	1956	1959	1961	1962	1963	1964
Boeing Co.	47.9		55.0	61.7	59.5	51.9	50.9	55.6
Douglas Aircraft Co., Inc.	30.8	59.7	51.6	47.9	61.1	54.6	53.1	39.4
General Dynamics Corp.		47.6	51.8	59.7	62.0	62.3	45.8	46.7
Grumman Aircraft Engineering Co.	48.3			56.8	59.0	59.4		64.5
Lockheed Aircraft Corp.	40.7	63.2	48.7	64.2	57.8	56.6	58.6	50.4
McDonnell Aircraft Corp.		46.1	47.9	58.1	48.6	52.2	58.7	64.3
North American Aviation, Inc.	33.9	52.9	11.3	52.8	50.0			53.0
Republic Aviation Corp.			68.2	39.4	61.9	52.6	57.0	
United Aircraft Co.				60.5	58.5		57.3	53.4
Swift & Co.	85.9		81.8	83.5	83.9	82.7	82.8	82.4
General Foods Corp.	74.9	80.1	79.0	76.4	68.7			72.2
E. I. duPont de Nemours & Co.	29.9	29.6	36.4	36.1	37.2	29.2	28.1	31.1
Union Carbide Corp.		43.3	42.4	44.5	47.1	46.1		
Humble Oil & Refining Co. ^b	62.9		45.5	46.5	45.4		44.1	
Goodyear Tire & Rubber Co.	59.9	51.8	51.1	51.1	47.5	47.3	47.7	45.6
United States Steel Corp.	41.6	36.8	35.8	35.2	30.7	29.2	33.3	34.0
Republic Steel Corp.	53.1	47.5	46.7	47.9	43.4	47.3	45.5	47.4
General Electric Co.	43.9	43.0	44.0	42.6	42.9	43.0	42.1	42.8
Bendix Corp.	45.4		50.6	47.3	50.3			49.7
General Motors Corp.	52.9	53.3	49.0	51.6	52.3	50.1	47.0	47.4
Ford Motor Co.		62.8	63.5	59.4	61.3	59.3	60.0	60.7
Chrysler Corp.	72.1		70.6	69.1	65.4		61.6	57.2
American Motors Corp.	62.9			65.6	71.0	68.8	66.7	68.7

SOURCE: 1949 data from Adelman, *op. cit.*, pp. 293-302. All other data from corporate financial statements.

^aTotal wages, profits, interest, depreciation and taxes, divided by sales, expressed as a percentage and subtracted from 100.

^bStandard Oil Co. (N.J.)

differs in its decisions about the best distribution of activities between in-house fabrication and subcontracting. The special characteristics of a firm, such as the nature of its products and its ability to take advantage of economies of scale in internal administration or marketing, will be among the factors that differ from firm to firm; these and similar factors will determine how much subcontracting is done by each firm.

Since the appropriate amount of subcontracting for a firm cannot be determined from knowledge about the industry or its technology, we must turn to the decision-making process within the firm in order to study subcontracting. Specifically, we must study how an entrepreneur determines the distribution of functions between his firm's internal activities and the activities of its subcontractors. The theory of vertical integration has been explored by a number of economists and some general principles are summarized in the Appendix. At this point, we need only note that from the standpoint of the economy as a whole, the purpose of subcontracting is to obtain a distribution of production and other functions among firms such that no real resources could be saved by a reorganization of in-house and subcontracted activities. In most parts of the economy competition is relied upon to achieve this result. An entrepreneur who discovers that by offering other firms a specialized service, or that by making use of the services of another firm, resources can be saved stands to make a profit. Likewise, an entrepreneur who discovers that resources can be saved by integrating a previously purchased activity within his firm will also make a profit. Competition motivates managers to make such resource-saving decisions and results in the savings being passed on to consumers. Will not the same forces lead defense contractors to select the most efficient distribution between in-house and subcontracted activities? Put more directly, what is the justification for regulation of defense contractors' subcontracting decisions?

The shortest answer to these questions is that competition in defense procurements is not sufficient to assure that the proper amount of subcontracting will occur automatically. This reply, however, requires elaboration. Most military procurements involve rivalry in the sense that more than one

potential supplier is considered as a prime contractor.* Yet, most prime contract awards involve contracts where price competition is not the means of selecting the supplier. This is the message of Tables 4 and 5.** It can be seen from Table 4 that the importance of price as a contractor selection criterion differs among the services. It is most important for the Defense Supply Agency and the Army, where it accounts for about two-thirds and one-third of the awards respectively. It is least important for the Air Force where only about one-sixth of the awards used price as the selection criterion.

Another vital aspect of military procurement that is apparent from Table 4 is the importance of "follow-on" procurement. For total Department of Defense purchases, and especially for the Air Force and the Navy, the single most important category of contract awards was follow-on procurement from a single source of supply determined by a previous contract that had been let by some form of rivalry. The magnitude of follow-on expenditures merits emphasis because such procurements have great importance for subcontracting policy, as will be discussed later.

The importance of design and technical rivalry in selecting contractors is apparent from Table 4, but is shown more dramatically by the data on Air Force expenditures in Table 5. In fiscal years 1962 through 1964, price was the criterion used to select contractors for about 14 per cent of all obligations, approximately 20 per cent of the component obligations, but only 8 per cent of the complete system

*A semantic note is perhaps in order. The military procurement literature usually uses the term "competition" in a broad sense to include all situations where several firms actively seek a contract. Thus, competition, in the military sense, occurs even when the selection of a contractor is made on a non-price basis, for example, when the selection criterion is the design of a weapon system or some other technical consideration. The economic literature, on the other hand, usually assumes that price will be the basis of selection when the term competition is used. To avoid confusion, this study will use the term rivalry to include both price and non-price competition. Unless otherwise stated, when the term competition is used, it will be assumed that the choice of a supplier is based on the price offered.

**The data in Tables 4 and 5 are for prime contracts only.

Table 4
RIVALRY IN DEFENSE PROCUREMENT, FISCAL YEAR 1964
(In \$ million)

Type of Procurement Action	Army		Navy		Air Force		Defense Supply Agency		Other Defense Agencies		Total	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
Multiple-source solicitation:												
Formally advertised	1,517	24.9	1,193	13.5	349	3.4	1,012	37.8	(a)	0.1	4,072	14.4
Other price competition	742	12.2	1,324	15.0	1,249	12.1	765	28.6	3	1.0	4,084	14.5
"Set asides" and open market purchases ^b	895	14.7	721	8.2	588	5.7	672	25.1	(a)	(a)	2,876	10.2
Design and technical rivalry	309	5.1	266	3.0	1,094	10.6	0	0	12	3.8	1,681	6.0
Single-source solicitation:												
Follow-on ^c	642	10.5	2,697	30.5	5,520	53.4	0	0	17	5.5	8,876	31.4
Other	1,984	32.6	2,626	29.8	1,535	14.8	228	8.5	273	89.6	6,646	23.5
Total	6,089	100.0	8,828	100.0	10,335	100.0	2,678	100.0	305	100.0	28,234	100.0

SOURCE: Directorate for Statistical Services, OSD, op. cit. p. 30.

NOTE: Detail may not add to totals because of rounding.

^a Less than \$0.5 million or 0.05 per cent.

^b Small business and labor surplus market set-asides and open market purchases of \$2,500 or less within the United States.

^c After price or design and technical rivalry.

Table 5
CONTRACTOR SELECTION METHODS IN AIR FORCE PROCUREMENT,
FISCAL YEARS 1962-1964
(In \$ million)

Contractor Selection Method	All Obligations		Major Components and Accessories ^a		Complete Weapon Systems ^b	
	Amount	%	Amount	%	Amount	%
Price rivalry:						
By advertising	976	3.2	548	7.0	0	0.0
By negotiation	4,249	14.0	1,013	13.0	362	8.4
Design and technical rivalry	19,474	64.4	4,226	54.6	3,807	88.2
Single-source solicitation	5,306	17.5	1,890	24.4	121	2.8
Not given	242	0.8	59	0.8	26	0.6
Total	30,248	100.0	7,736	100.0	4,316	100.0

NOTE: Detail may not add to totals because of rounding.

^aTotal obligations for FSC 12, 14, 15, 16, 17, 28, 29, 58, 61, and 66, less complete weapon systems.

^bTotal obligations for complete missiles and aircraft. FSC 1410, 1510, 1520, 1540, 1550.

purchases. Design and technical rivalry determined how 64 per cent of the total dollars, 55 per cent of the component dollars, and 88 per cent of the complete-weapon-system dollars were obligated.

Thus, for a large part of all purchases and especially for aerospace systems, contractors were selected primarily on the basis of the technical and design characteristics of the proposed system.* The significance of this fact is that there is no logical reason for expecting non-price rivalry to yield the same economic results as price competition. Specifically, there is no reason to expect the most efficient allocation of production between in-house and subcontracting when price competition is absent.

The last proposition can be demonstrated more precisely.** Consider the make-or-buy decision. A firm must analyze three variables: the in-house costs of production, (M),*** the "buy" costs composed of the invoice price, (B), and the associated administrative costs such as subcontract management, quality inspection, and so forth, (A).

Assume that the firm's goal is to maximize profit in the conventional sense, i.e., to maximize the value of the difference between all future revenue and cost streams appropriately discounted for time and risk. That is, the firm is assumed to maximize the present value of the owner's equity. Where the price of the output is denoted by P, and

$$(1) \quad P - M < P - (B + A),$$

then the profit-maximizing goal requires that the firm buy the item.

* Contractor selection by price rivalry differs fundamentally from selection by design and technical rivalry. Both involve, as shown in Table 4, consideration of more than one potential supplier. Nevertheless, with price rivalry the bids submitted by firms form the basis for choosing among technically acceptable suppliers and, in addition, the winner of such a competition is bound to his bid. This result may be obtained either by formal advertising or by negotiation, and Table 5 is so classified. With design and technical rivalry, however, all characteristics of the item are not fixed. The prices offered by potential suppliers may play a role in the Government's choice but neither it nor the successful firm is bound by the price. The target price is negotiated after the supplier has been chosen.

** We are indebted to S. S. Handel for helpful discussions on this point.

*** These are opportunity costs and so will vary depending upon the other feasible uses of the capacity, the need or desire to keep a labor force intact, and similar considerations. See Robert N. Anthony, Management Accounting, Richard D. Irwin, Inc., Homewood, Ill., 1956, pp. 355-367.

Alternatively, the firm would choose to make the item when the inequality is reversed. The assumption of price competition implies that P will be driven down to a level where one side of the inequality will yield a normal rate of profit on investment and the other side will yield a subnormal rate.

Note that the price of the output is a variable exogenous to the firm, set by competition and functionally unrelated to the other variables. For military procurement, the situation is quite different. In the purchase of weapon systems and their components, the price is usually not determined by the market. Also, the price is a function of the other variables. The competitive mechanism is replaced by a regulatory mechanism that sets prices on the basis of costs, such that the firm's profit rate on costs is "reasonable." Note that we now have a cost-plus pricing situation where the target profit is based on sales.* The managerial incentives involved in make-or-buy decisions are thus changed.

It is important to emphasize that this argument does not depend on the type of the contract. For all types, including cost-plus-fixed-fee, fixed-price-incentive, and fixed-price, the price and profit fee are functions of the contractor's costs, except where the contract is let with effective price competition among prospective suppliers and each bidder is bound to his offer. It is the endogenous functional relationship between price and cost that is vital for understanding subcontracting.**

Subcontracting decisions in the environment of the defense industries can be expressed in a form similar to inequality (1), above. The profit rates on in-house costs and invoice costs will be denoted by π_1 and π_2 , respectively. The price to the Air Force will equal costs plus profits. This price when the firm makes the item, denoted by P_m , will be

* Alternatively stated, a competitive firm faces an exogenously determined price and the result of its cost experience yields a profit. In military procurement a "reasonable" profit rate is first determined which multiplied by the expected cost yields a target profit. The expected cost plus the profit becomes the target price. Thus the direction of causation among price, cost and profit in military procurement is the reverse of that in a competitive market.

** As will be discussed later, the choice of a pricing arrangement for the prime contract does have an implication for public policy towards subcontracting.

$$(2) \quad P_m = M(\pi_1 + 1) .$$

Alternatively, the price to the Air Force when the firm buys the item, denoted by P_b , is given by

$$(3) \quad P_b = B(\pi_2 + 1) + A(\pi_1 + 1) .$$

Now suppose it would be less expensive for the Air Force if an item were bought, i.e.,

$$(4) \quad P_m > P_b ,$$

and assume further that there is no difference in profit rate, i.e., $\pi_1 = \pi_2 = \pi$. The question is, does the firm have an incentive to make the proper "buy" decision -- the decision that is in the best interests of the Air Force? The answer is clearly negative. In this situation the firm will choose to make the item because

$$(5) \quad M\pi > (B + A)\pi$$

even though from (4), above, we know that

$$(6) \quad M > B + A .$$

Therefore, with equal profit rates, the interest of the Government directly conflicts with the profit motive of the firm.

But what if the profit rate on in-house work is greater than that given the firm for work performed under subcontract? In other words, what about the case where $\pi_1 > \pi_2$? This case is especially relevant because it has applied in the actual environment since the introduction of weighted guidelines.* From the standpoint of the above example, a lower profit rate on invoice costs would give the firm an even stronger motive to make the item when the cost to the Government could be reduced by buying the item. Thus the same perverse decision rule is operating -- only now a bias has been added that further encourages the prime to make rather than buy.

* These provisions are covered in Section III, Part 7 of the Armed Services Procurement Regulation (ASPR).

It may well be that weighted guidelines, with their differential profit rates, have overcome the objections to profit-pyramiding voiced by the McClellan Committee.* They have not overcome the problem of insuring that make-or-buy decisions are in the best interest of the Government. For two reasons, differential profit rates will not solve the problem of obtaining efficient managerial subcontract choices. One is that as long as profit is tied to target cost, there is no incentive to minimize this target by efficient make-or-buy decisions -- unless the firm is bound to the target and the contract has been awarded to the firm with the lowest bid. The second reason is that to be effective, differential profit rates would have to be applied item by item on the basis of complete knowledge of alternative in-house and subcontracting costs. It is hard to imagine a contracting officer having such detailed cost information and if he did he would not have to rely on profit rates to achieve desirable results. A simple order would suffice.**

If we turn from the entrepreneur and examine the other party affected by subcontracting decisions, the Government, the rationale for a subcontracting policy becomes apparent. The previous discussion indicates that it is necessary to distinguish between three cases. The first case is one in which a prime contract with a fixed price is let after effective price competition. Here, the "Unseen Hand" is sufficient to assure that the prime contractor will select both the items to subcontract

*Committee on Government Operations, United States Senate, Pyramiding of Profits and Costs in the Missile Procurement Program, Senate Report 970, March 31, 1964, Government Printing Office, Washington, D.C., 1964.

**The algebra of subcontracting could be developed profitably in much more detail. Worthy topics of exploration are many; for example, how should the rates be set if the goal is to equalize the rate of return on real resources irrespective of the distribution of activities among firms? What if the goal is to equalize the rate of return to all firms involved? Are there conflicts between the desire to minimize the cost of weapon systems to the Government and obtaining the most efficient division between in-house production and subcontracting? However, these questions need not be resolved here -- we merely note their importance and concentrate on the rationale for a subcontracting policy.

and the subcontractors in a manner to assure that total system costs for a given purchase are minimized. The appropriate public policy in such a case is to leave subcontracting to the discretion of the prime contractor.*

Most weapon-system acquisitions, and a large part of other military procurements, however, do not fall in this category. In the absence of effective price competition, an active regulatory role for the Government is called for, since firms lack incentive to make the subcontracting decisions that will minimize costs to the Government. The degree of regulation, however, depends upon the contractor selection process and the pricing arrangement.

If a fixed-price-incentive contract is let with effective price competition, the contractor is motivated to minimize his target price; consequently, there is much less need for subcontracting regulation than in cost-reimbursable contracts. However, with sharing ratios such that the Government bears a large portion of the risks, the contractor may have an incentive to undertake the fabrication of items that will provide him with capital assets for future contracts, even though it may mean an accounting loss on his present contract.** This result would be impossible were it not for problems of accounting regulation and cost allocation. With an "ideal" cost accounting system, only the depreciation of the facility caused by the specific contract would be an allowable cost. Thus the relative attractiveness of subcontracting and in-house production would be unaffected. In the absence of "ideal" accounting systems, with fixed-price-incentive prime contracts, even those let by price competition, the Government has a legitimate supervisory interest in the prime contractor's decisions about which items to produce in-house. Regulation of the subcontractor selection process is unnecessary, however, as long as the subcontractors are truly independent of the prime contractor.

For all contracts in which effective price competition is not used to select the prime contractor, which necessarily includes all cost-reimbursable contracts, it is necessary to regulate both decisions

* The ASPR and other regulations recognize that no subcontracting supervision is required in this situation.

** Of course, a firm that made an habitual practice of this might find it hard to obtain new contracts. Almost any firm, however, can experience an occasional overrun without serious damage to its reputation.

about which items to subcontract and the subcontractor selection process. For all such contracts, there is a functional relationship between the profit fee and the initial or final cost estimate. Thus, there is no entrepreneurial motivation to make the subcontracting decisions that would minimize costs.

The upshot of the matter is that active regulation of subcontracting is necessary in today's procurement environment. And the key to effective subcontracting lies in the way suppliers are selected (including make-or-buy decisions). The remainder of this paper will explore present subcontracting regulations and some potential improvements from this standpoint.

III. DOES SUBCONTRACTING REALLY MATTER?

It was stated in Sec. II that the purpose of subcontracting is to obtain the division between in-house and non-integrated activities that results in the lowest cost to the Government for a weapon system. At the same time it was observed that the subcontracting ratios among firms and industries differ substantially. In many industries, indeed, firms that make extensive use of subcontracting compete effectively with highly integrated firms. Therefore, the question of whether subcontracting in defense products really matters must be discussed -- that is, whether the extent of subcontracting and the contractor selection process affects the price the Government pays for a weapon system. Put another way, despite the logic of the theoretical models, the actual relationships among in-house, invoice, and administrative costs might be such that the apportionment of the production of a system between prime and subcontractors would not significantly affect the final cost to the Government. Unfortunately, the data are not available that would allow rigorous analysis of this question for defense contractors or the aerospace industry as a whole. Although about half the procurement dollars spent by the Government flow through prime contractors to other firms, very little information is collected about subcontracting. Nevertheless, some notion of the value of effective subcontracting can be obtained.

Some important evidence about subcontracting comes from the experience with the procurement of the C-141, the Starlifter transport, produced by Lockheed. This program is instructive for two reasons. First, it indicates that some of the proposals to be made later in this paper are administratively feasible. Second, it indicates that subcontracting policy can have an important impact on the final cost to the Government.

The C-141 procurement program was unusual in several respects. First, the proportion of the system subcontracted was large and it included several major items that are not usually acquired by subcontracting. Second, fixed-price-incentive subcontracts were used extensively, possibly because the prime contract was FPI. Third, price competition played a major role in subcontractor selection. Fourth, this price

competition involved not only the development and production of the first aircraft for which Lockheed had a firm contract, but also included options on the total program quantity then visualized, 132 aircraft. Alternatively stated, subcontractors bid on the whole program as well as on the developmental phase, even though the development was the only phase for which Lockheed had a firm commitment.

The Air Force accepted Lockheed's proposed make-or-buy list without change. Shortly after the award of the prime contract, the Air Force and Lockheed agreed on an elaborate system of reviews and approvals of subcontract actions. While approval of the subcontract awards remained with the contracting officer, reviews were conducted by the C-141 System Project Office, the Aeronautical System Division Review Panel, and Hq USAF.

Thirty-one major subcontract items were subjected to competitive bidding (see Table 6). The subcontracts covered not only the equipment to be installed in the airplane, but a substantial part of the airframe as well. Noteworthy airframe items included the complete empennage and the complete wing assembly. Two airframe items accounted for over half the total program dollars subcontracted: the empennage and the wing box beams. Conventional industry practice has been for the prime contractor to produce most airframe items in-house.*

Several other features of Table 6 should be emphasized. First, the costs shown are really target costs, since most contracts were FPI. Second, a total of 151 bids were received on the 31 subcontracts, although Lockheed considered 27 of these to be technically unacceptable. This yields an average of approximately five bids per item, four of which were from technically acceptable firms. In only one case were there fewer than three prospective suppliers, and in only four additional cases were there fewer than three acceptable suppliers.

Virtually all items listed in Table 6 were subcontracted on the basis of price competition. These items represent well over half of all dollars expended outside by Lockheed.

* In two other recent aircraft programs, the F-111 and F-4, some major airframe elements also have been subcontracted.

Table 6

C-141 PROGRAM: SUMMARY OF ITEMS SUBCONTRACTED

Item	Low Acceptable Bid (in \$ thousand)		Number of Bids		Type of Contract
	5 Sets	132 Sets	Total	Unacceptable ^a	
Auxiliary power unit	86	2,240	3	0	FP
Electrical generating	115	2,821	3	0	FP
Constant speed drive	170	4,549	3	1	FP
Environmental System:					
Bleed air	56	1,469	3	0	FP
Air conditioning	148	3,914	3	0	FP
Pressurization	26	674	2	0	FP
High temperature shutoff valves	27	611	5	0	FP
Low pressure shutoff valves	14	259	5	0	FP
High temperature check valves	15	209	3	0	FP
Low pressure check valves	13	172	3	0	FP
Automatic flight control	91	2,343	5	0	FP
Aileron assemblies	109 ^b	1,614 ^b	4	0	FPI 90/10
Aft pressure door	12	102	8	2	FPI 90/10
Crew & rear entry doors	65	618	9	5	FPI 90/10
Emergency exit doors	19	215	12	6	RPI 90/10
Empennage	2,130	28,530	4	0	FPI 85/15
Wing flap tracks	224	4,456	3	2	FPI 85/15
Main landing gear	330	4,284	3	0	FPI 85/15
Main landing gear pods & doors	1,240	880 ^d	4	1	FPI 90/10
Nose landing gear	149	1,807	5	0	FPI 70/30
Nose gear doors & honeycomb exits	16	214	4	2	FPI 90/10
Nose radome	52	262	6	4	FPI 80/20
Power package	(e)	9,242	4	0	FPI 80/20
Roller assembly	17	307	9	(c)	FP
Wing box beam assemblies	2,240	44,230	6	0	FPI 80/20
Wing flaps	312	3,790	7	1	FPI 90/10
Wing leading edge assemblies	170	3,520	6	0	FPI 80/20
Wing spoilers	99	1,415	7	1	FPI 90/10
Wing trailing edge panels	62	1,146	8	2	FPI 80/20
Wing tips	14	154	4	0	FPI 90/10
Total	8,021	126,047	151	27	

SOURCE: All data furnished by the Lockheed Aircraft Corporation.

^a Does not include firms identified as unacceptable in the initial screening.

^b After rebid.

^c Engineering evaluation not available.

^d Doors only.

^e Not available.

Table 7
SUBCONTRACTOR SELECTION PRACTICES AT NINE PRIME CONTRACTOR PLANTS
(In \$ thousand)

Company	Price Rivalry		Design and Technical Rivalry		Follow-on After Rivalry		Single Source		Total Dollars Awarded by Prime		% of Total Dollars Awarded in Sample
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	
A	41,866	17	0	0	179,128	73	26,286	10	247,280	100	70
B	8,300	3	32,900 ^a	11	251,200	85	600	1	293,000	100	85
C	0	0	149,000 ^b	82	0	0	42,000 ^b	18	191,000	100	81
D	8,000	22	0	0	0	0	26,000	78	34,000	100	63
E	46,058	37	0	0	78,614	63	0	0	124,672	100	91
F	12,397	21	30,610 ^c	51	0	0	16,796	28	59,803	100	43
G	5,639	32	5,827	35	839	5	4,816	28	17,121	100	68
H	46,504	91	0	0	0	0	4,526	9	51,030	100	100
I	108,224	29	0	0	219,633	58	47,733	13	375,590	100	58
Total	276,988	20	218,337	16	729,414	52	168,757	12	1,393,496	100	60

SOURCE: Logistics Management Institute, Analysis of Extent of Competitive Procurement by DOD Prime Contractors, Washington, D.C., 1964, p. 29. The data are derived from a survey and include both actual and forecast totals. The period covered varies from two-year buy amounts to five-year buy amounts.

^a Combination of price and technical consideration under a multifactor source-selection procedure placed here under "Technical Rivalry" to be conservative.

^b Original technical and follow-on after technical competition combined; unidentifiable separately from data submitted.

^c Air Force Directed Procurement.

S . idea of the novelty of the extensive use of price competition in choosing subcontractors may be gained by contrasting the C-141 data with those shown in Table 7. The data in Table 7 are on a total-plant basis rather than a weapon-system basis, but it can be seen that on average only about 20 per cent of the subcontract dollars were let by price competition. To the extent that follow-on buys were negotiated using competitive bid information, the figure for price rivalry perhaps should be higher, but how much higher cannot be estimated. The data in Table 7, taken from a Logistics Management Institute study, include actual and forecast totals for buy-periods ranging from two to five years. Intercompany comparisons, therefore, are hazardous, but the over-all picture is instructive. It is evident that the C-141 subcontracting program involved far more than the customary amount of price competition, probably upward of 70 per cent of all outside purchases.*

Potential suppliers were requested to submit bids on the five-aircraft program and options on the follow-on production for 127 additional aircraft. They were also told that probably there would be a market for a civilian version of the plane, and additional military sales were possible. The vendors were requested to show their confidence in the over-all sales prospects by amortizing development and set-up costs over a larger number of aircraft than the five in the firm program. Where initial technical or cost uncertainties were substantial, Lockheed was prepared to share the risk by using fixed-price-incentive contracts, patterned after their prime contract.

The procedure for choosing among the prospective suppliers merits much attention. Informal "bidders conferences" and other devices were used to publicize the program and to resolve various technical questions. As a result, a number of bids were submitted by firms that Lockheed had not done business with traditionally.

*Based on an estimate made from data provided by Lockheed.

Lockheed evaluated the engineering, manufacturing, and quality-control capabilities of each prospective supplier. The scale used was such that firms rated at 200 or above were generally acceptable. Each prospective supplier understood that rivals were bidding. With only minor exceptions, awards were made to the technically acceptable firms that submitted low bids on the 132-aircraft program.

The results of the competitive bidding are summarized in Table 8. For the 132-aircraft program, the sum of the low bids was \$125.7 million, in contrast to the total of the low acceptable bids of \$126.0 million. Thus, almost no cost was incurred by ruling out firms that Lockheed considered to be technically unacceptable.

The startling variation in bids is indicated by the difference between the sum of the low acceptable bids, \$126.0 million, and the sum of the high bids, \$291.6 million -- a ratio of 2.3 to 1. The striking point here, indicating the importance of the contractor selection criteria, is the wide variation in the bids. On every major item there was always at least one bid that was at least twice as high as the low acceptable bid.

The sum of the mean bids, \$198.1 million, is significant because it indicates what the costs might have been had firms been chosen randomly with respect to price. In view of the traditional approach of dealing primarily with favored affiliates, the cost of a random choice may be a good first approximation of what the costs would have been had subcontractors been chosen in the manner traditional to the aerospace industry. Thus it could be argued that Lockheed's prudent selection of suppliers lowered the cost of items subcontracted by more than 35 per cent.*

*Computed as follows: $(198.1 - 126.0) / 198.1 = 36.4$ per cent. It is interesting that other studies of competitive bidding, though they use different techniques and are based on different data, produce estimates of the same magnitude. For example, see Logistics Management Institute, op. cit., p. 14. Long standing relationships among prime contractors and subcontractors might have some advantages to the parties that will be reflected in costs. Lack of information on this subject, however, makes the sum of the mean bids a reasonable estimate of what prices might have been had contractors been chosen in some fashion other than by competitive bids.

Table 8

C-141 PROGRAM: BIDDING RESULTS

I. Total target costs, 132-aircraft program (in \$ million): ^a	
A. Sum of low bids	\$125.7
B. Sum of low acceptable bids (from technically acceptable firms)	126.0
C. Sum of mean bids	198.1
D. Sum of high bids	291.6
Item C/Item B:	157.2%
Item D/Item B:	231.4%
II. Total target costs, 5-aircraft program (in \$ million): ^b	
A. Sum of low bids	8.0
B. Sum of low acceptable bids	8.0
C. Sum of mean bids	23.6
D. Sum of high bids	48.2
E. Sum for 5-aircraft program, using low acceptable bidders on 132-aircraft program	8.2
Item C/Item B:	295.0%
Item D/Item B:	602.5%

^aExcludes main landing gear pods.

^bExcludes power package.

It is easy to quarrel with any estimate of the benefits of competitive bidding, and certainly the one shown above is no exception. The C-141 program may or may not be representative of other programs. On one hand, the benefit is overestimated to the extent that supplemental agreements tend to be larger when low bidders are chosen. On the other hand, it may be too low. All bidders knew they were competing against rivals; therefore, some or all of the bids may have been lower than they would have been under some other selection procedure.

Other contractor selection procedures might have been used, of course. For example, Lockheed could have selected firms purely on the basis of technical excellence without regard to price. On the basis of Lockheed's technical evaluation, the bids of the firms with the highest rating on each item can be totaled. While not shown in Table 8, the total costs would have been \$198.6 million in this case. Again we observe that Lockheed's choice of bidders carries a lower cost by more than 35 per cent.

It can be argued that this last estimate is biased because it fails to take into account potentially important quality differences in the resulting products. Based on discussions with various Lockheed officials, there is little or no evidence that quality suffered as a result of their vendor selection procedure. Although the numbers shown below have been normalized to conceal the identity of the actual item and the particular bidders, they demonstrate a rather common phenomenon observed by Lockheed.

Firm	Normalized Technical Rating	Normalized Bid
A.....	99.2	100.0
B.....	97.9	161.9
C.....	100.0	205.1

The differences in the normalized technical evaluations are quite small, particularly between Firms A and C. In fact, Lockheed officials readily pointed out that their evaluation technique was

such that small differences in the evaluations could not be given much weight. In this particular case, they said that they were essentially indifferent between Firms A and C. Yet, as shown by the normalized prices, the selection of Firm C over Firm A on "technical" grounds would have doubled the cost of this item. It should be emphasized that an item-by-item analysis of Lockheed's purchases shows a pattern rather similar to that illustrated by the example.

Indeed, Lockheed officials have expressed pleasure with the quality of products supplied by bidders chosen on the basis of price. For the sake of argument, however, let us assume Lockheed is wrong -- that the quality of competitors' products does vary significantly, and that differences in price are the result of differences in quality. In other words, assume there is some relationship between a firm's technical rating and the over-all quality of its product. Technical ratings can then be used as proxies for quality and, by setting the low acceptable bid on each item equal to 100 and normalizing all other bids, the bids can be used as proxies for price. On this basis an analysis of price-quality correlations is possible.

For the 132-aircraft program there are 139 pairs of normalized prices and technical ratings. The correlation is slightly negative but not significant ($r = -.011$). Dropping the technically unacceptable firms leaves 113 pairs of data. In this case the correlation is slightly positive but again not significant ($r = .029$). For the 5-aircraft program, there is a total of 134 pairs of data. Here the correlation is negative and significant at the .01 level ($r = -.226$). Dropping the technically unacceptable firms gives 108 pairs of data and a negative correlation, significant at the .01 level ($r = -.405$).

Since a negative correlation implies that the low bidders produced superior items, it seems fair to conclude that at least there is no obvious positive correlation between price and quality. In other words, the differences in bids submitted cannot be attributed to likely differences in item quality.

In sum, considering the typically wide variation in bids, it is clear that the subcontractor selection method chosen can strongly affect total procurement costs. Also, considering the prime con-

tractors as a potential source of supply, these findings can be generalized to say that the make-or-buy list can also have an important impact on total system costs. In short, as the theoretical analysis leads one to believe, subcontracting does indeed matter.

While the results of the 5-aircraft program shown in Table 8 are less interesting, a few points are nonetheless worth noting. First, since there is no difference between the low bids and the low acceptable bids (\$8.0 million), no premium was paid by ruling out technically unacceptable firms. Second, the variation in bids is even greater than that observed for the 132-aircraft program, probably because of differences in the willingness of firms to amortize their development costs over larger production quantities. We note that the high bids are six times, and the mean bids nearly three times, as large as the low acceptable bids. Finally, since the choice of suppliers was based on the low acceptable bidders with the 132-aircraft program (rather than the 5-aircraft program), there is the question as to the size of the premium paid had the program been terminated after completion of the 5-aircraft program. Here we note that the sum of the low acceptable bids of the 5-aircraft program is \$8.0 million, as contrasted with \$8.2 million with the vendors actually chosen. In other words, only a small added cost could have been incurred as a result of making decisions on the basis of total program costs.

To finish the story of the C-141 program, a final unusual aspect of the program must be mentioned: the extensive use of options. Forward pricing is a major problem in military procurement in general, including subcontracting. Forward pricing is required because of the importance of follow-on procurement, discussed earlier in connection with Table 4. This problem was dealt with by requiring C-141 prospective subcontractors to provide options on the 127 planes for which the program was not firm. Contractor selection was on the basis of the low acceptable bidder for the entire program as it was then visualized. The significance of this feature will be discussed at greater length in Sec. IV.

The C-141 is an airplane well inside the frontier of aerospace technology. The time-phasing of design and production permitted an unhurried procurement. These facts, along with other demand and technological features of the program, mean that one must be careful about generalizing this case study to other purchases.* Nevertheless, the results of this program provide important evidence that many subcontracting innovations are feasible. Some of these innovations will be considered in the following discussion of subcontracting policies and procedures.

At this point, however, it is important to emphasize two conclusions that follow from the wide variation in the bids submitted by the prospective subcontractors for the C-141, regardless of how typical a program the C-141 may be. First, the choice of suppliers can have a very significant impact on total program costs. Second, the wide variation in bids means that there is every reason to doubt the ability to simulate the results of competitive markets, the implication being that "price analysis" is apt to be a poor substitute for price rivalry.

* The C-141 was, like some other recent aircraft, the subject of much Department of Defense effort to reduce costs and uncertainty, principally through analyzed, detailed work statements. Thus, the C-141 program contrasts with many previous weapon system acquisitions. Certainly a subcontracting program such as the one described here requires careful and detailed specification by both the Government and the prime contractor. Thus, the program definition phase has a major role in subcontracting.

IV. CURRENT POLICY AND POSSIBLE INNOVATIONS

The case for public concern about subcontracting regulation was developed in the last two Sections. At this point we turn to current subcontracting policy and some possible improvements suggested by the previous analysis. Subcontracting decisions arise for a defense firm in a somewhat different context than they do for other firms. In negotiating and carrying out a prime contract with a military organization, the firm must first prepare a "make-or-buy" list dividing the system to be delivered into three sets of items: those to be produced in-house, those to be subcontracted, and a third class of questionable items. After the make-or-buy decisions, subcontractors must be selected. Then the pricing arrangements and other terms of the contracts between the prime contractor and the subcontractors must be developed. This Section will be divided along similar lines. First, the amount of work to be subcontracted will be considered, then the subcontractor selection process, and finally, the terms of the contract between the prime contractor and the subcontractor.

AMOUNT OF WORK SUBCONTRACTED

It is the so-called "make-or-buy" program agreed to by the contractor and the Government that ultimately determines which elements of a system will be subcontracted, and, when all contracts are summed, the subcontracting ratio for the firm. Official guidance on the conduct of the make-or-buy program is remarkably general in tone. For the most part, the regulations on subcontracting can be compared to constitutional provisions, for they state broad principles without specifying how detailed decisions are to be made.

A make-or-buy list is a part of a contractor's written proposal for the production of any major weapon system. The regulations, (ASPR 3-902), state that this list must contain:

- (1) an identification of each major component or item of equipment,
- (2) a classification of each item in terms of "must make," "must buy," or "can make or buy,"

- (3) a further make-or-buy recommendation for each item classified as "can make or buy," and
- (4) sufficient information to permit the contracting officer to evaluate the proposed program.

The ASPR clearly implies that the contractor bears the basic responsibility for determining which items will be subcontracted, and thereby the proportion of the total purchase to be subcontracted. Specifically, the ASPR states that "... contractor's ... recommendations shall be accepted unless they adversely affect the Government's interests or are inconsistent with Government policy."

In evaluating the contractor's proposal, the contracting officer is instructed to "consider" a number of factors, among them being: the effect of plant loading on overhead costs, the capabilities of other suppliers, and the contractor's make-or-buy history. The appropriate variables for analysis are not limited to this list, nor is the weight to be given to any particular variable specified. In short, beyond the requirement that the make-or-buy list conform with other public laws and statutes, such as small-business and labor-surplus-market legislation, the procurement regulations leave the amount and composition of the make-or-buy list to the discretion of the contractor and the contracting officer.

The contracting officer is, however, given some explicit instructions about the items that the prospective supplier proposes to make. He is expected to challenge inclusion of an item if:

- (a) it is not regularly manufactured by the contractor, and is available from other firms at comparable prices; or if
- (b) it is regularly manufactured by the contractor, but is available from other firms at lower prices.

These criteria are not applicable, however, if subcontracting an item would increase the over-all cost of the program.

In sum, the ASPR implies that the goal of subcontracting, subject to such constraints as small-business and other "set aside" programs, is to minimize the cost of obtaining the items needed for our military position. Beyond this point, the regulations give little assistance. The contractor's decision about which items

should be subcontracted is, according to the ASPR, to be accepted subject only to the contracting officer's evaluation of some rather vague concepts. The burden of proof is on the contracting officer if he wishes to challenge a proposed "buy" item, despite the logical and historical evidence of profit-pyramiding by contractors.

On the other hand, the burden of proof is on the contractor for items he proposes to produce in-house. The criteria to be evaluated by the contracting officer on the basis of the contractor's evidence would be sensible except for one thing. Contracting officers do not have, nor is it easy to see how under prevailing circumstances they might ever have, the cost information that would allow them to compare the costs presented by the contractor with those of alternative sources of supply. This near-inability to apply the criteria of the ASPR reduces them to pious hopes rather than decision rules.

In the absence of operational decision criteria in the regulations, informal conventions have evolved about how the ASPR provisions should be interpreted. It appears that the contractor shoulders the burden of proof if he proposes to make an item he does not regularly manufacture. This burden could be discharged by showing that he has a cost advantage over alternative suppliers -- a proposition that may not be demonstrable even if true. For items the contractor regularly manufactures, the prime contractor is presumed to have a cost advantage over other possible suppliers. The result is that the prime finds it easy to continue his traditional activities, but difficult to integrate new activities into his firm.

Thus, the impact of the informal interpretation is to preserve the "status quo" division of firm specialization. Since there is no mechanism for generating the cost data necessary to establish the desirability of a change in the distribution of functions or activities among firms, the result is that each firm is protected against encroachment by other firms on his present markets, but is in turn prevented from encroaching on theirs.

The notion seems prevalent throughout the ASPR and other literature that the division of items in terms of make-or-buy is governed primarily by technological or other considerations apart from cost.

However, the C-141 experience and other recent weapon-system procurements clearly indicate that there are relatively few inputs where make-or-buy is dictated by purely technical factors.*

The main point here is that the only real control over the make-or-buy list stems from conventional rules about traditional product lines. There is no reason to believe that such rules will result in the most efficient allocation of production among firms. With the data presently available to a contracting officer, however, it is hard to see how he could do any better. Thus, the problem is to devise some new procedures that will give him a more adequate information base for his decisions. This is a major theme of this study, to which we shall return after the discussion of subcontractor selection criteria.

SUBCONTRACTOR SELECTION CRITERIA

There is no privity between the Government and subcontractors. Nevertheless, a number of policies of the Department of Defense and other agencies influence the way prime contractors choose suppliers.** The basic authority for approval or review of each major subcontract rests with the contracting officer. He is instructed by ASPR 3-903.4 to "give appropriate consideration" to:

- (1) whether the decision to enter into the proposed subcontract is consistent with the contractor's approved "make-or-buy" program, if any;
- (2) whether the proposed subcontract will require the use of Government-furnished facilities;
- (3) the responsibility of the proposed subcontractor;
- (4) basis for selecting proposed subcontractor, including the degree of competition obtained;

*In the F-4 program, for example, even some of the design function was subcontracted.

**As in the rest of this study, no attention will be given here to a number of socio-political policies affecting subcontracting. Among these policies are The Small Business Act of 1953 (Public Law 85-536, 15 USC 631), and the Aid to Surplus Labor Areas program (National Emergency Proclamation, Executive Order 2914, Dec. 16, 1960, DMP #4, June 6, 1960). Also, of course, such laws as the Copeland Act (40 USC 276) and the Walsh-Healy Act (41 USC 35) apply to subcontracts as well as prime contracts.

- (5) cost or price analysis in price comparisons accomplished, with particular attention to whether cost or pricing data are accurate, complete, and current;
- (6) extent of subcontract supervision;
- (7) estimated total extent of subcontracting, including procurement of parts and materials;
- (8) types of contracts used; and
- (9) the extent to which the prime contractor obtains assurance of the adequacy of the subcontractor's purchasing system.

For our purposes, two of the factors listed above are especially relevant. These are the role of competition and the basis for subcontractor selection (item 4), and the cost analysis and price comparisons accomplished (item 5). ASPR 3-903 also provides for Government supervision of the prime contractor's purchasing system, and applies to subcontracts and purchases in general. It offers the same general guidance on the two factors noted above, in almost identical language.

Supervision of the prime contractor's purchasing system plus the review of each major subcontract constitute the method by which the Government regulates subcontracting.* The elaborateness of the attendant review procedures varies among military commands. The most well-developed procedure is generally considered to be that of the Air Force Systems Command. The extensive nature of the process is indicated by noting that the AFSC Contractor Procurement Review Manual, AFSCM 70-3, is 85 pages long. It contains various references to pricing practices and the role of competition. Section G, for example, defines the concept of "adequate and effective competition." It sets forth a rather stringent set of requirements for adequate competition--requirements that in the procurement of highly technical items rarely can be satisfied precisely. Even so, it does recognize that "the buyer should still obtain several quotations, if it is

*The Logistics Management Institute and the Directorate of Procurement Policy, Hq USAF, have given considerable attention to this function in recent years. See for example, Logistics Management Institute, op. cit.

practical and feasible for him to do so." In general, however, the emphasis is on conditions that must be present before a supplier is chosen on the basis of a low price bid, rather than on the role of competitive bidding in the imperfect world in which highly technical items are procured.

The problems of administering a subcontracting program and the Governmental review will not be considered here. While there are many important issues, our interest centers on the problem of how subcontractors should be initially selected. The finest possible administration of a subcontracting program cannot compensate for poor decisions about which items should be subcontracted and who the vendors should be. Contrariwise, a sound make-or-buy list and a sound selection of subcontractors will make administration easier for both prime contractors and the Government.

The ASPR makes it clear that competition in subcontracting is a "good thing," but it does not define the structure or the performance of a market that may be regarded as competitive. Can competition consist of merely inquiring whether each of two firms might be interested in a contract? Is competition an exhaustive solicitation of all known producers? Is duopoly (two sellers) competition? Is competition limited to price rivalry or does it include design and technical rivalry? This list of relevant and unanswered questions could be extended almost ad infinitum. At the risk of appearing facetious, one can say that the most important change imaginable in the ASPR would be the addition of a glossary.

In a more serious vein, competition, as used in the economic literature, may refer either to the structure of a market, the results of a market operation, or the conduct of firms in a market.* A

* Edward S. Mason, Economic Concentration and the Monopoly Problem, Harvard University Press, Cambridge, Mass., 1957. Joel B. Dirlam and Alfred E. Kahn, Fair Competition, Cornell University Press, Ithaca, N. Y., 1954.

competitive market structure implies that price and the other market variables are not endogenously determined by a firm, or by firms acting in overt or implicit concert. A competitive market result implies that prices, costs, profits, investment, and the rate of innovation have certain desirable relationships. Competitive conduct implies that firms attempt to maximize profits in a socially acceptable, nonconspiratorial fashion.

The ASPR appears to view competition in the market conduct sense. It may be an overly broad reading of the language, but the regulations appear to presume that prime contractors will attempt to minimize the costs of fulfilling a given contract by aggressively seeking the lowest-cost source of supply -- including themselves as one source. There are two problems, however. As discussed in Sec. II above, in the absence of effective competition in letting a prime contract the firm has no incentive to behave in this fashion. Second, there is reason to question the cost estimates that are used by both the prime contractors and the Governmental reviewing officials. The variation in bids observed in the C-141 subcontracting program prompts one to question the credibility of "price analysis," particularly when made in the absence of spirited price rivalry.

If we are to obtain an effective subcontracting program, we must have some system that generates meaningful data about the costs of alternative sources of supply. The most feasible method is competitive bidding. Competitive bidding, in the sense it is used here, need have little resemblance to formal advertising. Presumably the bidding would utilize a procedure that would be classed as negotiation, although the exchange of technical information would be similar to two-step advertising. The necessary conditions are widespread information about the prospective purchase, the enumeration of the requirements and terms, and then the submission of bids on various likely production quantities. The prime contractor would have to make adequate technical evaluations to eliminate any technically unacceptable firms. Should the prime contractor desire to let the contract to a firm other

than the lowest bidder, the technical evaluations would play an important role in the Governmental review of the subcontract.

Bids should be submitted on various likely program quantities. Bids on lot sizes other than the preliminary purchase would serve two purposes. First, they would provide a basis for adjusting targets if the size of the program should be changed. Second, if the initial contract is for less than the total prospective or possible program, then price protection during the remaining production can be obtained by the use of options derived from the bid information.*

In evaluating the feasibility of such a method, the C-141 program is instructive. At least for a state-of-the-art weapon system, it appears that competitive bidding can be used for practically every major item subcontracted. With more sophisticated and advanced systems, bidding might be restricted, but substantial opportunities should remain. The key here appears to be the adequacy of program definition.

The number of items that can be subcontracted, and the opportunities for competitive bidding, will depend on the skill and motivation of the prime contractor. As pointed out by Lockheed officials, the designs chosen, the master tooling used, and the lifting procedures employed substantially influence the opportunities for subcontracting. The attention given to these problems can either place the contractor in a strait jacket or give him a great deal of flexibility.

It was noted earlier that present regulations call for the submission of a make-or-buy list during the proposal stage of a program, and for the further classification of some of the items as "must make." The procedure is correct, but the criteria for classifying an item as "must make" should be re-examined. The "must make" list should include only those items that are absolutely essential to the role of the prime contractor in managing and integrating the weapon system. The manufacturing capabilities or aspirations of the potential prime contractors are irrelevant.

After the award of the prime contract, the regulations should require that all suppliers of other items on the make-or-buy list

*The usefulness of options is described more fully in the discussion of subcontract provisions, which follows.

be chosen on the basis of competitive bidding.* The prime contractor and any of his subsidiaries would be free to bid on any item on the list, even when the item differs sharply from the traditional product lines of the prime contractor.

By no means does competitive bidding as the term is used here imply that awards would necessarily go to low bidders. Indeed, awards would depend on technical evaluations and perhaps other cost information as well as the results of price rivalry. The point here is that even when the results of price rivalry do not dominate the choice of vendors, they can materially add to the information otherwise available. The burden for justifying any departure from the routine use of competitive bidding would be on the prime contractor.**

This procedure would not be a one-way street for the prime contractor. The bidding procedure is designed to give the prime contractor far more freedom to adapt and change the specialties of his firm. One of the disadvantages of present subcontracting policy is that it tends to retard firms that wish to develop new products and specialties. This is certainly undesirable from the prime contractor's point of view, especially during a period when military demands and industrial technology are changing substantially. One advantage of competitive bidding is that the prime might be able to bid against potential subcontractors in order to obtain an item for in-house production, even though it falls outside his traditional product lines. The responsibility for investment decisions would thereby be returned to the prime contractor. From the stand-

* Except when the prime contract is a fixed-price contract preceded by price competition.

** There are several situations in which competitive bidding is impossible or meaningless. For example, when there is literally only one source of supply it is impossible; and, when the uncertainties are so large that a cost-reimbursable subcontract is let, competitive bidding is meaningless.

point of the Government, such bidding would assure that the choice between subcontracting and in-house production results in the lowest cost for the weapon system as a whole. From the prime contractor's standpoint, such bidding would allow him to vary his activities and capabilities over time. In addition, both parties would benefit by having fewer disputes to resolve.

Is it feasible to place a prime contractor in competition with other prospective suppliers? The answer appears to be affirmative, but some problems must be faced. The first problem was noted earlier, when it was observed that design and technical barriers to buying an item might be created by a contractor who wished to produce an item in-house. This would seem to be an appropriate problem for Governmental officials to worry about at the program definition stage. The second problem concerns the means by which a prime contractor could be bound by his bid on items when he competes against potential subcontractors. The prime contractor might be bound in either of two ways. The first would be to adjust the target of the prime contract by replacing the cost assigned to this item with the bid on the item when negotiating the target for the system as a whole. This procedure would be simple and would require only one contract with the weapon-system supplier. It would require, however, that the initial target cost be broken down item by item, and this is not always done.

A second, and probably superior, method would be to write a separate contract with the prime for the item on which he was the low bidder.* This method would require two or more contracts with the prime contractor and so would be administratively more complex. However, there are two points in defense of this proposition. First, administering the contracts would not, in general, be more cumbersome than administration where the contract is awarded to a separate supplier by the prime contractor. Second, and very important, there would only be

* For some administrative purposes the item might be handled like Government-furnished equipment. The prime contractor, of course, would have complete responsibility for performance and system integration.

a handful of items where this procedure would be used, even for a very large program. It might also be objected that there would be cost-allocation problems if the prime contract were CPFF and the other were FP or FPI. At worst, the problems here would be no worse than they are under the present system, and on the other hand, there is a real possibility for the Government to obtain meaningful information about relative costs of in-house production and subcontracting.

SUBCONTRACT PROVISIONS

Since there is no privity between the Government and a subcontractor, the provisions of a subcontract are primarily governed by the desires of the prime contractor and the vendor.* Of course, because the prime contractor's procurement system and his subcontracts are subject to review and approval by the Government, there is an important indirect Governmental influence. In addition, many statutes and Executive Orders apply to both prime and subcontracts for military products.** Further, subcontracts often resemble the associated prime contract. Because most of the features of subcontracts are determined by general contracting principles or by the usual features of all military contracts, we need go into only two special aspects of subcontracts. These aspects are the pricing arrangement between the prime and subcontractor and the provisions affecting follow-on procurements.

There is no particular reason why the prime and subcontracts should have the same pricing arrangement. Even though a prime contractor might have a CPFF contract, it would be foolish for him

* McDonald, op. cit., pp. K-1-1 to K-1-3. Section K, entitled "Subcontracting," contains a useful discussion of the provisions that by law or Executive Orders must be included in subcontracts. The section also discusses common practices in writing subcontracts as well as some of the policy issues in this area.

** For a list of such laws and orders, see ibid., pp. K-1-4 to K-1-6.

not to purchase a standardized, "off-the-shelf" item by a fixed-price contract. On the other hand, in theory, there is no reason why a prime contractor with a fixed-price contract might not let a cost-reimbursable contract with a vendor. Of course, in such a case the prime would bear all the risks of the subcontractor's cost outcome without being able to pass unfavorable results along to the Government, and thus would probably have little motivation for such an arrangement. The relevant point, however, is that the risk associated with any single item is likely to differ from the risk associated with the system as a whole. Therefore, the pricing arrangement in any subcontract might well differ from the pricing arrangement for the prime contract.

The C-141 program illustrates the use of different sharing arrangements for items with different risks. This principle might be extended. If a competitive bidding arrangement were used to select subcontractors, it would be necessary at some point before the bids were made to decide on the type of contract and the associated sharing arrangement. Once this were done, the resulting bids would be influenced by the risk-reducing abilities and risk preferences of each potential source of supply. For some items, the prime contractor might either be able to control the risk more effectively, or might have a different attitude toward bearing risks from that of the potential subcontractors. In such a case it would be desirable, ceteris paribus, from the Government's standpoint, that the prime contractor produce the item in-house. A bidding procedure that allowed him to compete against potential subcontractors would permit an objective appraisal of this matter.

The follow-on procurement features of a subcontract are matters of extreme importance. As has been emphasized many times before, follow-on procurements account for the major part of the total weapon-system procurements. In addition, follow-on procurements are a major source of policy conflicts, both between the military establishment and the defense contractors, and between the military establishment and the General Accounting Office and Congress.*

* See the sixth industry newsletter (n.d.) in the series sent by Lt Gen T. P. Gerrity to the 100 largest aerospace contractors under the general title, "Systems and Logistics News for Aerospace Industry."

If no provision is made in a subcontract for future purchases, the prime contractor may face a dilemma. He may have to deal with the original supplier because the latter is the only source with the knowledge and capability to produce the item to the original specifications, or the prime contractor may have to develop a new source. This latter choice may be expensive because of set-up costs, the need to obtain plans and drawings, claims of proprietary data, and like problems. Conversely, unless the initial vendor has some assurance that potential future sales may accrue to him, he will have to depreciate his investment and set-up costs over the units for which he has a firm contract. This allocation will increase the cost of the initial items.

The Air Force has attempted to resolve this dilemma at the prime-contract level by using the technique of multiyear procurement. A single contract is let for the total program purchases over several fiscal years. Thus, even though only the first-year purchases have been obligated in the Federal budget, the prime and subcontractors can plan their production and pricing over a larger number of units.* Presumably, multiyear procurement will be reflected in subcontracts.

There are two difficulties with this solution. The first is that it is not useful for programs in which the total number of items to be purchased is highly uncertain. Thus, with most weapon systems for which the amount purchased at later stages is determined in part by the results at the early stages, multiyear procurement has

* Lt Gen Gerrity's newsletters emphasize this effect. See especially the sixth letter (n.d.) and the eighth letter, November, 1964. See also the statement by the Comptroller General of the United States in Joint Economic Committee, Subcommittee on Defense Procurement, U.S. Congress, Impact of Military Supply and Service Activities on the Economy, Hearings, March 28, 29 and April 1, 1963, Government Printing Office, Washington, D.C., 1963, pp. 112-141.

serious drawbacks.* Second, it is, in effect, a requirements contract that binds both parties. In procurements subsequent to the first purchase, consequently, the Government is unable to use suppliers offering lower prices.

Options, such as those used in the C-141 program, are a superior technique. An option differs from the multiyear system of requirements contracts in that only one party -- the vendor -- is obligated. The prime contractor has the ability not to exercise the option should a lower-price supplier appear. In other words, the prime contractor is protected from being "locked-in" to a subcontractor on future procurements. From the subcontractor's point of view, his initial bid can reflect the likelihood that he will be the supplier for future purchases.

Options should be requested for all relevant likely program quantities. Options are not only useful in selecting the vendor, but allow the Government to remain completely flexible about its future demands. Of course, options cost the buyer money. It is not likely, however, that options in weapon-system acquisitions would cost the Government any more than it now pays under the requirements-contract approach to follow-on procurement. In any event, price protection and flexibility are highly desirable aspects of a procurement program and well worth some added cost.

In sum, two aspects of subcontract provisions merit close attention. One is the adjustment of pricing arrangements to the risk involved with a specific item. The second is the use of options to deal with follow-on procurements. A number of innovations are possible, as demonstrated by the C-141 example. The pay-off from these innovations might well be substantial.

* Where future purchase quantities are known with substantial predictability the major problem of follow-on procurement is matching fiscal accounting to the life cycle of a system. This condition often applies for spare parts purchases. The problem here, however, concerns the problem of selecting a supplier for a known but small quantity of items which may lead to the purchase of a larger amount the exact magnitude of which can be estimated with only limited accuracy.

V. POLICY IMPLICATIONS

The need for public regulation of subcontracting in weapon-system procurement hinges on the rivalry that prevails in the selection of prime contractors. There are three cases. The first applies when price rivalry is used to select the prime contractor, and the low bid provides the basis for negotiating a fixed-price contract. In this case the prime contractor should be free to decide what he will subcontract and who the subcontractors will be. It should be of no concern to the Government whether an item that the prime contractor proposes to make falls within his traditional product lines or activities. Nor does it matter whether the prime enjoys a cost advantage or disadvantage in relation to other possible suppliers. An inefficient choice of suppliers may be merely a deliberate investment decision by the prime contractor. This view is consistent with current procurement regulations.

The second case applies when fixed-price-incentive contracts are let and the results of the price rivalry form the basis for negotiating the initial target. In this case the prime contractor should be free to choose subcontractors, unless investment decisions of the prime are involved. Review of individual subcontractors should not be required so long as the prospective suppliers are independent of the prime contractor. If the Government is to avoid subsidizing his investment decisions, however, the same freedom cannot be granted to the prime contractor in make-or-buy choices.*

The third and final case is the one of primary interest, for it applies in the vast majority of weapon-system purchases. It applies whenever price rivalry among prime contractors is absent, regardless of the type of contract ultimately negotiated, and thus includes all

*That is, with an incentive arrangement such that the Government pays a share of the costs, the contractor may find that an inefficient decision to fabricate an item in-house is a way to obtain a capital facility or a new capability financed by public funds. This result would be impossible were it not for imperfections in accounting regulation and cost allocation procedures. Only the depreciation of the facility caused by the specific contract would be an allowable cost and thus the relative attractiveness of subcontracting and in-house production would be unaffected with perfect cost accounting.

reimbursable contracts (CPFF or CPIF). Fixed-price-incentive contracts that are let in the absence of price rivalry are by far the most important class, and it is to this class that our attention is directed. This attention is proper, because the need for improved public policy towards subcontracting is most vital here.

In the third case, there is a basic conflict between the Government's objective to obtain the system at least cost and the contractor's objective to maximize profit. The contractor is motivated to maximize target cost, for this not only maximizes the target fee but increases the likelihood of an underrun. The cost estimates he uses in negotiating a target can be expected to have an upward bias, due to simple over-estimation of costs and to inefficient choices regarding what will be subcontracted and who the suppliers will be. Even if an inefficient choice is irreversible, i.e., the make-or-buy decision is unalterable during the contract life, it can increase the target fee, and presumably the final fee, though the size of overrun or underrun is unaffected. Of course, these problems could be avoided if the Government had adequate and independent cost estimates. However, the extreme variation in bids observed among prospective C-141 subcontractors strongly indicates that it is utopian to hope for a cost-estimating technique that could take the place of price rivalry among firms.

Thus, when the market mechanism cannot be relied upon as the regulator of subcontracting decisions, public regulation of subcontracting should be an integral part of military procurement policy. Regulation should go well beyond the present review process, to include the amount of work to be subcontracted and the make-or-buy decisions in particular, the process by which subcontractors are selected, and subcontract arrangements that provide price protection for follow-on purchases. Even though there is no privity between the Government and subcontractors, such regulation appears consistent with present executive practice.

Current regulations dealing with make-or-buy decisions imply a "natural" or "technical" division between "must make" and "must buy" items; the available military and commercial evidence shows great variation in the extent of subcontracting (or its converse, the amount

of vertical integration). A prime contractor should be viewed as an engineering organization responsible for managing and integrating the production of a weapon system. The mere fact that he has an in-house capability to manufacture certain items does not necessarily imply a cost advantage over other prospective suppliers -- nor should the lack of a capability from an historical standpoint rule out the possibility that he really may have a cost advantage.

Although the available evidence has limitations, it appears to be feasible to use competitive bidding in both make-or-buy choices and subcontractor selection. Under favorable circumstances competitive bidding can provide an adequate basis for source selection; and even under far less favorable circumstances it can still materially supplement the information on which decisions would otherwise be made.

During the proposal stage of the prime contract, a list would be prepared that identified all major components or items of equipment called for under the program, along the lines of the present make-or-buy list. From this list the "must make" items would be carefully selected -- limited strictly to those items that the prospective prime contractors and the Government consider essential to the role of manager and systems-integrator, without regard to the manufacturing capabilities of the firms. No other make-or-buy decisions would be made until after the award of the prime contract.

After the letting of the prime contract, all remaining items on the make-or-buy list would be purchased, using price rivalry among prospective suppliers to the fullest extent possible. Policy would call for competitive bidding as a matter of routine. The burden of demonstrating the inappropriateness of price competition would rest with the prime contractor. However, the prime contractor would have the opportunity to bid on any item, without regard to his traditional activities or product lines. The administration of the program, conducted along the lines of two-step advertising, would be handled jointly by the prime contractor and the buyer. The contracting officer would monitor all parts of the program and handle the bids on those purchases where the prime contractor was a candidate.

Despite some obvious problems in introducing such a program, it offers several important advantages. First, available evidence suggests

that the opportunities for lowering the cost of weapon systems through more efficient source selection could prove substantial. Second, prime contractors would have the opportunity to change their product lines and thus adapt to changes in military demands and technology. Finally, both parties would benefit from a method that aroused fewer disputes over make-or-buy choices and the selection of vendors.

Competitive bidding will be useful only if follow-on procurements are handled effectively. Usually two or more contracts are issued in the development and production of a weapon system. The first contract ordinarily covers the development of the system and the production of a few end items, primarily for test and evaluation. Additional contracts are used to purchase larger quantities of the item for operational use. This procedure creates a problem because a subcontractor chosen under the initial contract may enjoy many of the advantages of a monopolist when the time comes for follow-on procurements.

One way to deal with this problem is to procure a weapon system under a single-package contract, perhaps using "bundle bidding" along the lines suggested by Assistant Secretary Charles.* This approach is not common, although proponents of the plan cite the Navy's VAL program as precedent.** Of course, this approach does not cope with the problem of uncertainty, at the time the first contract is let, about the total quantity of the system that will ultimately be purchased. Experience has shown that the total size of a program frequently depends on the characteristics of the product and these characteristics may not be revealed until the program has been under way for some time.

An alternative approach that appears to offer great promise involves the use of options. The idea here is to obtain competitive bids on various likely production quantities (program sizes) at the outset of the program. For quantities other than those covered in the initial contract, the bids represent option prices that can be used in follow-on

* Address by Honorable Robert H. Charles, Assistant Secretary of the Air Force (Installations & Logistics), to the AFLC/Industry Management Conference, Dayton, Ohio, June 25, 1964, pp. 12a-15.

** Ibid., p. 12a.

contracts. By this procedure, vendors are chosen on the basis of total program costs, thus removing much of the disadvantage of bargaining with a monopolist in subsequent production contracts. At the same time, the prime contractor and his subcontractors can plan for production quantities larger than the initial purchase. The Government also retains flexibility about future demands.

Most of the changes that are suggested are completely consistent with the current goals of procurement as enunciated in relevant legislation. In addition, they are consistent with the spirit of the ASPR provisions on subcontracting and with many of the methods used to achieve procurement policy goals. Indeed, only two changes in the ASPR would be needed. One involves the timing of make-or-buy decisions. The suggestion here is to postpone make-or-buy decisions, except for carefully screened "must make" items, until after the award of the prime contract. The second suggestion would require a change in the ASPR to permit a prime contractor to compete with subcontractors in selecting sources for other items on the make-or-buy list. Of course, with those items that the prime contractor desires to make and therefore elects to engage in the competition for, the process must be administered by Government contracting officials. Although something of an innovation, this does not materially alter the Government's involvement in the process nor the basic responsibilities of the contracting parties.

In sum, when prime contractors are selected on the basis of effective price competition, the market mechanism can be relied upon to regulate subcontracting decisions. However, when effective price competition at the prime contract level is not achieved, some of the benefits of competition can still be gained through competition in make-or-buy choices and in subcontractor selection. Today's procurement environment, in which price competition is usually absent in the award of prime contracts, calls for a more active public policy toward subcontracting if efficient decisions are to be made. Current policy offers many opportunities for improvement. The innovations discussed here, we believe, would materially improve the effectiveness of subcontracting in the defense industries.

*For the reasons discussed in Sec. I, the analysis has focused on the goal of obtaining the weapon systems needed for our defense position at the minimum cost.

APPENDIX

SOME ECONOMIC ASPECTS OF SUBCONTRACTING

An exploration of the economic theory of subcontracting, (or its converse, integration), was not required for this study.* For the study it was only necessary to show the wide variation among firms in their use of subcontracting and to note that the social function of subcontracting is to obtain an efficient distribution of activities among firms. At this point, however, it may be helpful to expand slightly on these points.

Differences in subcontracting ratios are the result of differences in the relative costs of the two major coordinating devices of our economy: firms and markets.** The transformation, in form, lot-size, geographical position, or time of availability of an item as it passes from basic factors of production to a consumable item in the hands of the final customer, can be analyzed as a series of processes or activities. These activities must be coordinated into systems. In general, such systems are organized on one of two bases: administrative or contractual relationships. In the first type of system -- firms -- the various activities are organized on the basis of hierarchical relationships among subunits and decision-makers. This relationship is defined by a "chain of command." Markets represent a more complex method of organizing processes or activities into systems. Here the units and decision-makers are independent as defined by ownership or agency rights. The control mechanism consists of contracts made on the basis of signals generated by prices. Alternatively stated, the function of a market-price system is to coordinate activities; the distinctive feature of a

*This study also did not consider the conceptual and statistical problems involved in measurement of subcontracting or vertical integration. For discussions of these points, see Nelson, op. cit. and Adelman, op. cit.

**R. H. Coase, "The Nature of the Firm," Economica, New Series, Vol. 4, 1937, pp. 386-405; reprinted in George J. Stigler and Kenneth E. Boulding, Readings in Price Theory, Richard D. Irwin, Inc., Homewood, Ill., 1952, pp. 331-351.

firm is that it supersedes this coordinating device with the function of the manager or entrepreneur.*

A basic decision that any entrepreneur must make is what the scope or size of his firm will be. This decision has two dimensions: how many functions will be integrated into the firm's organization, and for each function, what the level of activity will be. Subcontracting affects these decisions in two ways. First, the firm instead of integrating some activity into its internal organization may obtain the results from another firm. Second, in determining the level of activity for those processes integrated into the firm, the firm may choose an activity level higher than needed for the system as a whole, and dispose of the excess output through the use of markets. Or, it may choose to produce less internally than needed by the whole system and obtain the remainder by contract. For example, a firm may choose not to have a legal staff within the firm but may use independent counsel; or, it may have an integrated legal office but supplement this function by contractual relationships.

Two activities may be so related that they are almost always under joint administrative direction. Quality control and fabrication are seldom separated by markets. In other cases, coordination by markets may be technologically feasible but cost conditions may make administrative control almost always the rule. Production of pig iron and steel is an example here. In other cases, one may find markets and firms performing the same coordinating functions with few apparent advantages for either method. For example, in the timber-lumber complex there are six distinguishable markets: timber-growing, harvesting, saw-milling, finishing, wholesaling, and retailing. Some firms operate at only one stage, others combine two or more stages, and a few are integrated over all six.

Viewing subcontracting as part of system coordination has several implications. First, for the economy as a whole the average proportion of subcontracting will be determined by the relative costs of marketing on the one hand, and internal managerial control on the other. As

* Ibid., p. 334.

communication and transportation technology and factor prices change, the relative attractiveness of the market as a coordinating mechanism changes. As administrative techniques, internal control devices, and related factor prices change, the relative attractiveness of in-house production changes.

Second, any industry's technology and the nature of its demand will imply some average proportion of subcontracting. This ratio may be very different from that of the economy as a whole.

Third, any specific firm may have a subcontracting ratio different from the average for its industry or for the economy as a whole. The differences may be due to the peculiarities of the firm's products, its ability to take advantages of economies of scale in internal administration or marketing, or to other managerial decisions about which processes it wishes to engage in and the activity level of each process.

Fourth, in a dynamic environment the subcontracting ratio for any firm, industry or the economy at large is likely to change over time. Two opposing forces are at work. One force is economies of scale. As an industry expands economies of scale for firms become possible for certain processes and these may be split off to become new industries with separate firms.* The other force is risk and uncertainty. When the technology of a production process is poorly understood or when other factors, such as style-demands, make an activity risky, firms may prefer to have independent suppliers bear these risks rather than integrate such activities into their firms. As risk decreases -- for example, as the technology of a process becomes better understood -- firms may choose to integrate these functions. The history of radio set manufacturing is a case in point.**

The decision to produce a specific item in-house or to subcontract it presents itself to the firm in two forms: as an investment or as a

* George J. Stigler, "The Division of Labor is Limited by the Extent of the Market," Journal of Political Economy, June 1951, pp. 185-193; Adelman, op. cit., pp. 318-320.

** Raymond Vernon, Metropolis 1985, Harvard University Press, Cambridge, Mass., 1960, p. 76.

make-or-buy proposal. The first, in part, determines the activities that the firm is capable of performing. The second, in part, determines the level of each activity. Alternatively stated, the make-or-buy decision is relevant where changes in the fixed assets of the firm do not enter into the decision. The investment decision is relevant where the firm's plant and capabilities can be adjusted.

When one examines actual interfirm relationships, the clear distinction between the firm and the market as system-coordinating forces and the distinction between make-or-buy and investment distinctions becomes blurred because of long-term contractual or conventional relationships among firms. For example, assume two firms are parties to a requirements contract specifying that for the next twenty years firm A will purchase all its needs from firm B, and B will supply all of A's requirements. Does this represent integration of B's activities, or a part thereof, into A? What if there is no contract, but merely a traditional, unwritten agreement that A will always buy from B?

This study is concerned only with those aspects of the general problem of firm scope that affect subcontracting policy. Therefore, we need only note that certain long-term contractual or traditional supply relationships between firms for most purposes are equivalent to integration of the supplier's activities within the purchasing firm. (The most important difference is how risks and uncertainties are shared among different stockholders.) Thus, the data on subcontracting have an upward bias because they do not reflect requirements contracts, traditional relationships and other forms of quasi-integration. Also, some of the traditional relationships among firms in the defense industries mean that transactions between them are economically more similar to intrafirm transfers than to subcontracting.

In conclusion, from the viewpoint of the firm, subcontracting decisions are required in order to take advantages of the relative costs of internal administration and the use of markets. These relative costs will vary from firm to firm depending on the specific characteristics of each firm. Theory leads one to expect the wide variation among firms and industries in the use of subcontracting that is shown by the empirical data. Therefore, the "appropriate" amount of subcontracting for a firm cannot be specified by general knowledge about an industry or the economy.